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# **RESTRICTED AND FULL-FEEDING OF GROWING PULLETS**

**WEST VIRGINIA UNIVERSITY AGRICULTURAL EXPERIMENT STATION**



## Summary

The results of a 12-year study of methods of growing New Hampshire pullets indicate that good pullets may be grown by any of the 11 methods studied. The results may be summarized as follows: (1) Range-reared pullets which were limited to a two-hour feeding time for five days per week and a light feeding of grain on the other two days consumed about 15 per cent less feed in 20 weeks than full-fed range-reared pullets consumed in 16 weeks. (2) Sexual maturity of the limited-fed pullets was retarded an average of 25 days and egg size was increased. (3) Growing pullets fed only whole grain and minerals while on range consumed more, but cheaper, feed during the 20-week growing period than the full-fed range-reared pullets consumed in 16 or 17 weeks, reached 10 per cent production 29 days after the full-fed pullets and 37 days later than confinement-reared pullets, and produced the largest eggs. (4) Confinement-reared pullets required slightly more feed than the others, were the earliest maturing pullets, and laid the smallest eggs. (5) The rearing methods studied had little or no effect on egg production or mortality in the laying pen. (6) Of the methods studied here, the feeding of only whole grain and oyster shell\* to range-reared pullets during the growing period was the easiest to use. Its cost would depend upon market conditions.

\*Minerals: Crushed limestone, size #10, may be used also.

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## THE COVER

An experimental brooder house at Reymann Memorial Farms Substation designed so that lots within treatments are the same with respect to housing.

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AGRICULTURAL EXPERIMENT STATION  
COLLEGE OF AGRICULTURE, FORESTRY, AND HOME ECONOMICS  
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# Restricted and Full-feeding of Growing Pullets

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## Introduction

**H**OW can better quality replacement pullets be grown at a lower production cost? This is not a new question. It has been debated ever since poultry keeping became more than a side line on the general farm.

Since the middle 1930's numerous, but radically different, methods of growing pullets have been proposed and studied. The results of controlled research studies of these different methods began to appear in the literature during the middle 1940's, but it was not until about 1955 that the reports appeared in volume. Many of the reports were contradictory. This made it difficult to formulate definite conclusions. In an attempt to evaluate this volume of contradictory literature, Table 1 was developed by one of us (J.K.B.). This table summarizes the research reports that have contained data on the characteristics and performance of pullets grown by different methods. Because researchers do not report data in the same way, it was impossible to average the results of all the experiments reported. Therefore, the reports were summarized by indicating the number of times pullets grown on a certain method have excelled in a particular characteristic. For example, ten comparisons, Table 1, were found in which the amount of feed consumed was determined for full-fed range and confinement-reared pullets up to the time both groups reached a certain age near sexual maturity. In six of these comparisons the range-reared pullets consumed the least amount of feed during the growing period, while in three comparisons the confinement-reared pullets consumed less feed than pullets grown on range. In one study the range and confinement-reared pullets consumed the same amount of feed.

In summarizing the research reports, a comparison was considered to be the average of all the replicate lots which had received similar treatments. Thus, if a researcher repeated his study each year for three

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years, the average of the three-year study was considered as one comparison. In determining which treatment should be credited with having consumed the least amount of feed or with having produced the most eggs, for example, the actual differences were used regardless of whether or not the researcher considered the differences large enough to be statistically significant. Small, consistent differences often may be just as important to producers as those which the researcher found to be large enough to be statistically significant.

Five different comparisons of methods of growing pullets have been considered in this summary of the literature. They were: (1) full-feeding on range with full-feeding in confinement, (2) full-feeding with feeding time limited to a certain time period, (3) full-feeding a complete diet with full-feeding whole or ground grains and minerals, (4) full-feeding with the amount of feed limited to a per cent of that consumed by the full-fed group, and (5) full-feeding a relatively high energy diet with high fiber diets full-fed or restricted to the amount consumed by the groups receiving the high-energy diets.

The criteria used as a basis for comparing the feeding methods included feed consumed during both the growing and laying periods, body weight at the end of the growing period and sometime during the laying period, mortality during both the growing and laying periods, age at sexual maturity or when a certain per cent of production was attained, egg production, and egg size.

Different researchers started their various treatments at different times, usually after the pullets were 8 to 12 weeks of age, and continued them for various lengths of time, frequently discontinuing the treatments at about the time the early-maturing birds reached sexual maturity. There are no indications that these variations had any major effect upon the results of the experiments. All groups were reported to have been full-fed during the laying period.

*Effects during the growing period.* The pullets which consistently consumed less feed during the growing period than the groups with which they were compared were those which were limited either in feeding time or to a per cent of what the full-fed groups consumed, and those groups fed the high-energy diets. However, when the treatments were continued until the birds which received restricted feeding reached sexual maturity or until a low rate of production was attained, sexual maturity was, in some cases, delayed long enough to permit the pullets on a restricted program to consume more feed up to the time of sexual maturity than the birds which had been full-fed.

The amount of feed saved by limiting the feeding time to about two hours per day was generally about 5 to 10 per cent when based on



full feeding period, unless when feed also was withheld from the birds for two days each week. Under the latter conditions feed intake was reduced from 20 to 30 per cent. When the amount of feed saved was about 5 to 10 per cent, the body weight at the end of the treatment period was slightly reduced in most comparisons. In one comparison the restricted birds were heavier and in three comparisons exactly equal to the full-fed groups. This indicates that decreasing feed intake 5 to 10 per cent during the growing period is not a severe treatment.

Many comparisons have been made between full-fed lots and those restricted to 15 to 30 and a few up to 50 per cent of as much feed as consumed by the full-fed group. The average body weight of the limited groups was less than that of the full-fed group in all but one of the comparisons. The exception was a group of pullets fed a diet containing 5 per cent added fat but restricted to 30 per cent of as much feed as that consumed by the full-fed group. Apparently, the full-fed group was not utilizing the extra feed it was consuming. In over two-thirds of the comparisons, the full-fed groups had the least mortality during the growing period. Sexual maturity of the restricted groups was delayed in 28 of 30 comparisons, but in about one-half of these the delay was less than 10 days.

In the high energy versus high fiber comparisons, the groups fed the high-energy diets not only consumed less feed during the growing period but had greater body weights at the end of the growing period than did the groups fed the high-fiber diets. While the fiber was added to attempt to lower the nutrient intake of the growing pullets, it is questionable as to how effectively this was accomplished unless the birds were given limited amounts of feed. It was reported that the addition of 6 per cent fiber usually increased feed intake 5 to 6 per cent, and in one comparison the addition of 20 per cent fiber increased feed intake 56 per cent. The high-fiber diets delayed sexual maturity but had no effect upon mortality during the growing period.

The growing period feed consumption of the range-reared pullets was less than that of pullets grown in confinement in only 6 of 10 comparisons. This indicates that range or confinement conditions may be quite important in determining the relative amount of feed consumed by growing pullets. Range rearing did appear to affect body weight by producing pullets with smaller body weights than those grown in confinement. Range rearing did not consistently affect mortality during the growing period. Several reports indicated that losses in the range-reared lots due to wild animals or stray dogs were not considered in calculating the mortality. Had these losses been considered, the mortality

of the range-reared groups would not have been as favorable as it appears in Table 1. In 9 of 11 comparisons, range-reared birds reached sexual maturity later than the confined pullets. This increase in age at sexual maturity was small. In only one comparison was it as much as 11 days.

The use of only whole or ground grain, or a combination of whole and ground grain, and a mineral supplement did not consistently affect feed consumption during the growing period. Pullets fed the complete diet had the greatest body weights in six of eight comparisons. Sexual maturity of the grain-fed groups varied from no retardation to as much as eight weeks. This characteristic appeared to be relatively unaffected, if unlimited amounts of range were available and if some of the grain was fed in the ground form.

*Effects during the laying period.* Egg production appears to have been consistently improved by range rearing or by limiting the feed of the restricted group to a percentage of that consumed by full-fed pullets. In all of the comparisons summarized, the range-reared pullets laid more eggs than the confined pullets. Many of the comparisons were considered by the researchers to be too small to be statistically significant. While the differences vary from less than 1 per cent to 5.6 per cent, the average appears to be slightly more than 2 per cent in favor of the range-reared pullets.

Limiting the feed of the pullets to a percentage of that consumed by the full-fed groups improved egg production in 22 of 33 comparisons. Twenty of these 33 comparisons were conducted with White Leghorn or Leghorn-type pullets. Only 11 restricted groups of these 20 comparisons had better production than the full-fed groups. Of the 13 comparisons conducted with heavy breed pullets—mostly New Hampshires or White Rocks—11 of the restricted groups had the best production. This indicates a possible difference that is not apparent with the other methods of feeding growing pullets.

The ability of the pullet to lay larger eggs appeared to be associated with delayed sexual maturity. This appeared to be particularly true with the range- versus confinement-reared comparisons and with those groups limited to a per cent of the feed consumed by the full-fed groups. In the latter group there is the possibility of a breed difference affecting the summary. Of 20 comparisons conducted with White Leghorns or Leghorn-type pullets, only 11 of the restricted groups laid larger eggs than their full-fed sisters, but 8 restricted groups out of 9 comparisons conducted with heavy breed pullets laid larger eggs than the full-fed groups. This indicates that Leghorn-type pullets did not respond to restricted feeding in the same manner as the heavier birds.



TABLE 1. SUMMARY OF THE NUMBER OF COMPARISONS NOTED IN THE LITERATURE IN WHICH PULLETS GROWN BY DIFFERENT FEEDING METHODS WERE EQUAL OR SUPERIOR TO THOSE WITH WHICH THEY WERE COMPARED AS MEASURED BY NUMERICAL (BUT NOT STATISTICALLY SIGNIFICANT) DIFFERENCES FOR CERTAIN CHARACTERISTICS<sup>1</sup>

CHARACTERISTICS OF PULLETS	FULL-FED RANGED VS. CONFINED			FULL-FED VS. LIMITED FEEDING TIME			COMPLETE FEED VS. WHOLE OR GROUND GRAIN			FULL-FED VS. LIMITED PER CENT OF FULL-FED GROUP			HIGH ENERGY VS. HIGH FIBER DIETS							
	No.	R	C	E	No.	E	L	E	No.	CF	WG	E	No.	F	L	E	No.	HE	HF	E
Growing Period																				
1. Least feed per bird—to given age .....	10	6	3	1	17	0	17	0	5	2	3	0	30	0	30	0	13	13	0	0
sexual maturity .....	2	0	2	0	2	1	0	1	2	2	0	0	6	3	3	0				
2. Largest body weight at housing .....	14	1	12	1	18	14	1	3	8	6	2	0	36	35	0	1	16	16	0	0
3. Lowest mortality .....	11	6	3	2	13	7	5	1	3	2	1	0	30	22	8	0	15	7	7	1
4. Oldest at sexual maturity	11	9	2	0	14	3	9	2	8	0	6	2	30	2	28	0	17	1	14	2
Laying Period																				
1. Highest production .....	16	16	0	0	15	6	7	2	7	1	3	3	33	10	22	1	14	8	6	0
2. Largest egg size .....	12	8	1	3	12	3	7	2	1	1	0	0	29	7	19	3	14	4	10	1
3. Lowest mortality .....	14	11	3	0	15	6	7	2	1	1	0	0	33	14	15	4	15	7	5	3
4. Largest body weight .....	8	6	1	1	12	5	2	5	3	0	3	0	28	20	6	2	12	5	6	1
5. Least feed per bird .....	5	1	3	1	8	3	5	0	3	0	3	0	22	2	19	1	5	4	1	0
6. Highest hatchability .....	5	4	1	1	6	1	4	1					5	4	1	0				

<sup>1</sup>Key to abbreviations in table headings:

No. — total number of comparisons for each characteristic  
and each method of feeding

R — range  
C — confined  
E — equal

F — full-fed

L — limited feeding time or per cent of full-fed group

CF — complete feed

WG — whole or ground grain

HE — high energy

HF — high fiber

The only groups of pullets that tended to have lower mortality than those with which they were compared were those reared on full feed on range and heavy breed pullets limited to a per cent of the feed consumed by their full-fed sisters. When both Leghorns and heavy breeds are considered together in the later comparison there is no effect of treatment. When considered separately, 13 full-fed groups out of 23 comparisons conducted with Leghorn-type pullets had less mortality than the restricted groups, and three groups had equal losses. However, 8 groups out of 10 comparisons studied with heavier breeds had less mortality than the full-fed groups.

Mature body weight was slightly larger for most of the full-fed range-reared groups and for the full-fed groups compared with groups limited to a per cent of the feed consumed by the full-fed groups. No breed differences were noted.

The method by which the pullets were fed during the growing period did not appear to affect total feed consumption during the laying period except that the per cent-limited groups consumed less feed than the comparable groups that had been grown on full feed. Apparently these groups laid more and larger eggs, but consumed less feed than the full-fed groups. This may have been due to the smaller adult body weight of the birds that had been restricted. This effect was noted in all breeds studied. It was contrary to most beliefs concerning restricted pullets.

The West Virginia University Agricultural Experiment Station began studying methods of growing pullets before most of the work summarized in Table 1 was published. The purpose of the experiments reported herein was to compare the growing and laying period responses of full-fed New Hampshire pullets grown on range or in confinement with that of range-reared pullets which had had their feed restricted during the growing period. Several methods of feed restriction were studied.

## Experimental

For the series of experiments discussed here all chicks were grown in a brooder house until they were two to three months of age, and then they were placed on unlimited well-sodded range or confined to a growing house. Each growing-period treatment was assigned to one lot of about 100 pullets during the first four years but to two lots of about 100 pullets during each of the last eight years of the experiment. At housing time (23, 24, or 28 weeks of age) the pullets available from each growth-lot were placed in separate laying pens. During the last



six years, all restricted-fed lots were retained on their growing period and during the laying period; all lots in any one year were treated alike. Data were obtained on egg production, total egg weight, body weight, feed consumption, and mortality.

It can be considered that the first six-year period, 1943-44 to 1948-49, was one of screening. During that time 27 different lots of pullets were used to study 11 different methods of feeding growing pullets. The methods are listed in Table 2.

Of the methods tested it appeared that several should be studied extensively. During the next three years, 1949-50 to 1951-52, duplicate lots of pullets were grown each year on: (1) full feed of growing mash and grain on unlimited range; (2) full feed of whole grains and oyster shell on unlimited range; and (3) full feed in confinement. During the last three years, 1952-53 to 1954-55, the confined lots were replaced by range-reared groups whose feeding time was limited to two hours per day for five days a week and a light feeding of grain on the other two days (Wednesday and Sunday).

TABLE 2. PER CENT OF EGG PRODUCTION FOR FIRST SIX YEARS OF STUDY

FEEDING SCHEDULE USED DURING GROWING PERIOD	SERIES 1	SERIES 2	SERIES 3	SERIES 4	SERIES 5 <sup>1,2</sup>	SERIES 6 <sup>1,5</sup>
<i>Range-reared Groups</i>						
Full-fed, mash and grain (controls) .....	51.46	52.53	44.63	55.35	54.56 <sup>3</sup>	59.29 <sup>3</sup>
Limited, 2 hours, 7 days per week .....	54.36					
Limited 2 hours, 5 days per week; grain only, Wed. and Sun. ....	49.92					
Limited, morning feed only (mash and oats 2 hours) .....		51.60				
Limited, afternoon feed only .....		50.11				
Full-fed, 6 days per week .....			45.27			
Full-fed, all mash .....			47.23			
Full-fed, reduced mash, increased grain .....				55.94		
Full-fed, ground grain, and oyster shell .....				59.43		
Full-fed, whole grains, and oyster shell .....				56.22	54.40 <sup>4</sup>	55.14 <sup>4</sup>
<i>Confinement-reared Groups</i>						
Full-fed .....			49.87	56.99	50.77	48.35

<sup>1</sup>Average of two lots.  
<sup>2</sup>All lots had Newcastle disease during January.  
<sup>3</sup>Chicks hatched 1 week earlier than confined lots.  
<sup>4</sup>Chicks hatched 4 weeks earlier than confined lots.  
<sup>5</sup>Chicks had an outbreak of epidemic tremors during the brooding period.

During the last six-year period the groups fed the whole grains and oyster shells, as well as those whose feeding time was restricted, were hatched four to five weeks before the groups that were full-fed a complete diet either on range or in confinement. Experiences of the first six years indicated that these earlier hatched pullets, grown as indicated above, would require this additional time to reach sexual maturity. Thus, by using different hatch dates an attempt was made to have pullets that would reach sexual maturity on about the same calendar date. Such a procedure was considered desirable in order to remove the possible effects of staggered maturity dates on laying house performance.

## Results and Discussion

*First six years (Series 1 to 6).* Feed consumption during the growing period was not reduced when the pullets were allowed access to mash and grain for about one-half of each day, or when they were full-fed either ground or whole grains of wheat and corn. However, restricting the feeding time to two hours a day for five or seven days a week did reduce feed consumption about 24 per cent during the growing period. Pullets grown in confinement consumed more feed than those grown on range. The confined pullets were the first to reach sexual maturity, while those whose feeding time was restricted to two hours a day and those grown on the whole grain and minerals were the last to reach sexual maturity. The earlier-maturing lots usually laid the smaller eggs, whereas the late-maturing lots laid the largest eggs. The effect of the treatments on egg production is summarized in Table 2. The lots at the top of the table, which were full-fed growing mash and whole grain on range, were considered the controls. The per cent egg production was somewhat inconsistent; however, there is an indication that the retarded pullets laid at a slightly higher rate during the time they were in production than did the pullets grown on full-feed.

*Second six years (Series 7 to 12).* The feed consumed per pullet during the growing period is summarized in Table 3. Even though the pullets fed whole grain and minerals were on range three or four weeks longer than the ones full-fed mash and grain, they consumed only about 10 per cent more feed. Generally, such a feeding program would be cheaper than the use of mash and grain on range. The pullets grown in confinement consumed more feed in two of the three years and had a slightly higher average feed requirement than the full-fed birds grown on range. The pullets grown on limited feeding consumed about 15 per cent less feed than the full-fed birds even though they were on range four weeks longer than the latter.



TABLE 3. POUNDS OF FEED CONSUMED PER PULLET DURING GROWING PERIOD, AND NUMBER OF WEEKS ON RANGE OR IN GROWING PENS<sup>1</sup>

SERIES	RANGED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
	<i>lbs. (weeks)</i>	<i>lbs. (weeks)</i>	<i>lbs. (weeks)</i>	<i>lbs. (weeks)</i>
7	20.86(17) <sup>2,3</sup>	22.31(20)		21.92(17) <sup>3</sup>
8	19.98(16)	23.00(20)		18.75(16)
9	18.51(16)	22.39(20)		20.28(16)
Average	19.78	22.57		20.32
10	20.31(16) <sup>3</sup>	21.06(20)	16.30(20)	
11	20.95(16)	23.74(20)	16.78(20)	
12	20.73(16)	20.94(20)	19.20(20)	
Average	20.66	22.21	17.43	
6-year Average	20.22	22.39		

<sup>1</sup>Average of two replicate lots.  
<sup>2</sup>Numbers in parentheses indicate number of weeks on range or in growing pens.  
<sup>3</sup>These chicks were placed on range or in growing pens at 7 weeks of age—  
all others at 8 weeks of age. Age at housing is the *total* of 2 and 3.

The effect of the growing treatments on the age when the pullets reached 10 per cent production is summarized in Table 4. Since the birds were not trap-nested, it was impossible to obtain the average age in days at sexual maturity, individually. Age at 10 per cent production was arbitrarily chosen as a means of comparing age of sexual maturity. Pullets grown in confinement reached 10 per cent production an average of 12 days earlier than the full-fed range groups, while those fed whole grain and oyster shell and those on limited feeding were retarded 27 and 25 days, respectively. This effort of limited feeding is greater than is generally reported by other workers. Thus, while the restricted pullets were

TABLE 4. AGE IN DAYS WHEN PULLETS REACHED 10 PER CENT PRODUCTION<sup>1</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
	<i>(controls)</i>			
7	183	206		179
8	185	208		172
9	183	212		166
Average	184	209		172
10	180	209	208	
11	187	212	211	
12	191	223	213	
Average	186	215	211	
6-year Average	185	212		

<sup>1</sup>Average of two replicate lots.

older than the full-fed pullets, they did reach sexual maturity at about the same time of the year.

The effect of the growing treatments on egg production is summarized in Tables 5 and 6, which give the average per cent production on the hen-day basis and the average egg production per hen on a hen-housed basis. This latter method of circulation takes the mortality into account. The results are variable, with no consistent trend. It is interesting to note that the full-fed range pullets laid at a very slightly higher rate of production than did the pullets raised in confinement (Table 5). However, when the results of the comparisons made during the first six years of the study are combined with those of the second six years, it is noted that the range-reared pullets averaged 52.25 per cent

TABLE 5. AVERAGE PER CENT PRODUCTION<sup>1,2</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
7	50.39	52.55		51.13
8	47.43	44.88		47.70
9	54.08	60.07		51.80
Average	50.63	52.50		50.21
10	55.94	55.48	59.80	
11	52.88	51.48	54.78	
12	50.68	49.16	49.51	
Average	53.17	52.04	54.70	
6-year Average	51.90	52.27		

<sup>1</sup>Hen-day basis.

<sup>2</sup>Average of two replicate lots.

TABLE 6. AVERAGE EGG PRODUCTION PER HEN HOUSED<sup>1,2</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
7	151.1	156.0		150.4
8	131.6	125.5		130.4
9	160.4	173.1		143.0
Average	147.7	151.5		141.3
10	161.6	156.8	171.1	
11	160.6	148.2	159.0	
12	153.0	148.5	145.5	
Average	158.4	151.2	158.5	
6-year Average	153.1	151.35		

<sup>1</sup>Average of two replicate lots.

<sup>2</sup>Total production during the first 308 days in the laying house.



and the confinement-reared pullets 50.94 per cent production. This difference is small and in line with that noted in the literature review. Actually, the range-reared pullets laid at a higher rate of production than did the confinement-reared pullets in only three of the seven years, but, whenever the range-reared pullets laid at a higher rate of production, the rate was markedly higher than that of the confined pullets. The reverse was not true. It should be noted, however, that these data are interpreted as indicating that good production may be expected from pullets grown on any of the methods tested.

During the last six years of this study, all the eggs from each pen were weighed daily and then sorted into weight grades. Table 7 summarizes the average egg weights in ounces per dozen, and Table 8 indicates the per-

TABLE 7. AVERAGE EGG WEIGHT<sup>1</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
		<i>(ounces per dozen)</i>		
7	24.61	25.33		24.02
8	24.40	25.49		24.24
9	24.59	25.90		24.37
Average	24.53	25.57		24.21
10	24.06	24.86	24.60	
11	25.33	25.90	25.25	
12	25.25	25.57	25.31	
Average	24.88	25.44	25.05	
6-year Average	24.71	25.51		

<sup>1</sup>Average of two replicate lots.

TABLE 8. PER CENT OF TOTAL EGGS WEIGHING 23 OR MORE OUNCES PER DOZEN<sup>1</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
7	79.04	89.43		72.72
8	76.78	88.83		74.75
9	76.78	91.51		71.74
Average	77.53	89.92		73.07
10	63.72	72.45	73.62	
11	82.29	90.07	83.93	
12	81.86	87.26	82.12	
Average	75.96	83.26	79.89	
6-year Average	76.75	86.59		

<sup>1</sup>Average of two replicate lots.

centage of eggs from each treatment group which weighed 23 or more ounces per dozen. During the entire six-year period, the pullets which had been fed whole grain and oyster shell on range laid larger eggs than those which had been grown on any of the other treatments, while those grown in confinement consistently laid the smallest eggs. It should be noted that the differences reported in Table 7 appear rather small, but the differences in Table 8 are rather large. Since eggs are often sold on a weight grade basis rather than on average egg weight, Table 8 becomes most meaningful for producers, and particularly for those producing hatching eggs.

Figures 1 and 2 indicate that the differences in egg weight were most pronounced during the first six months of the laying period. After that time the effects of rearing methods tended to disappear. While the restricted pullets were about a month older than the other pullets, at most any comparable age they laid a higher per cent of eggs weighing 23 ounces or more per dozen than the full-fed pullets laid except near the end of the laying period. This is not in agreement with several reports considered in the literature review in which it was indicated that egg size was associated with the age of the bird and that treatments which resulted in delayed sexual maturity would increase average egg size only by eliminating the small eggs at the beginning of the laying period.

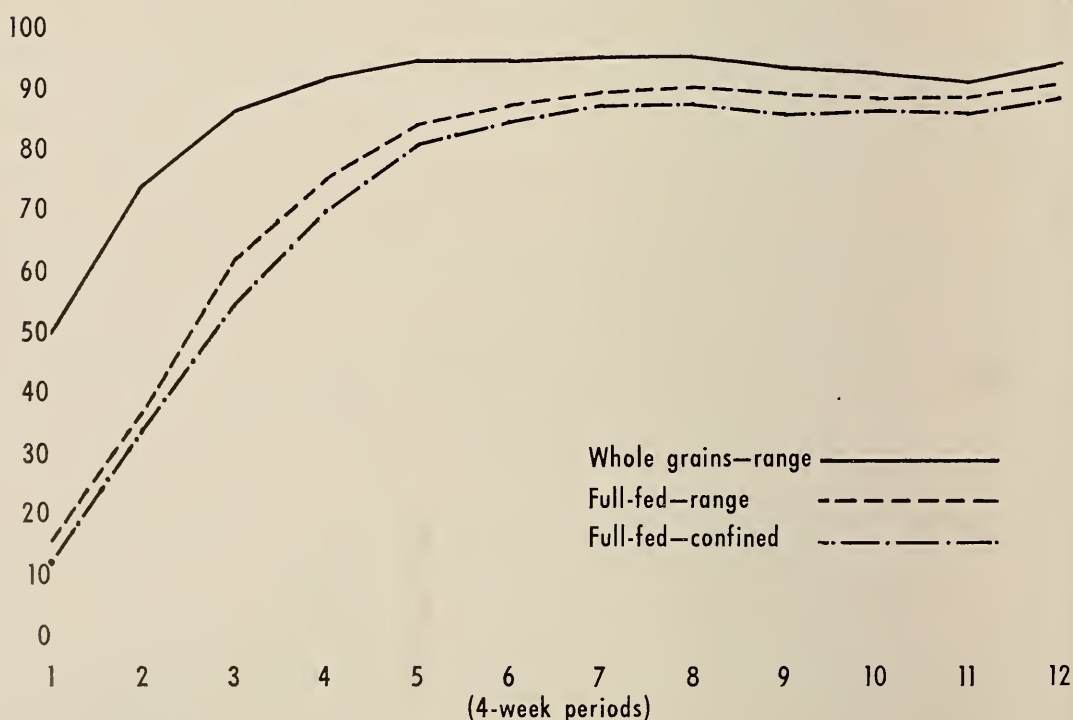


FIGURE 1. Per cent of eggs weighing 23 ounces or more per dozen—Series 7, 8, and 9. Average of years 1949-1950, 1950-1951, and 1951-1952.



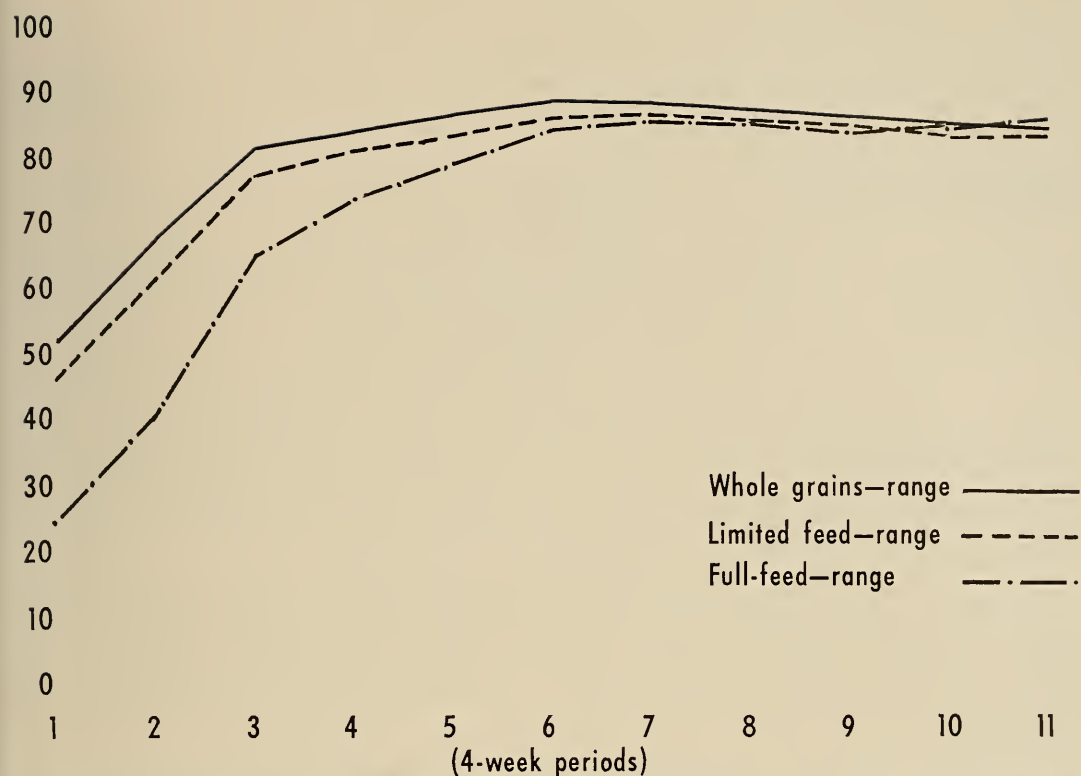


FIGURE 2. Per cent of eggs weighing 23 ounces or more per dozen—Series 10, 11, and 12. Average of years 1952-1953, 1953-1954, and 1954-1955.

The effects of rearing treatments on laying house mortality are summarized in Table 9. The averages were quite variable between years, between treatments, and between lots on the same treatment within years (not shown in Table 9). This is due to the fact that the loss of a very few birds has a relatively large effect upon these percentage figures. While the full-fed, range-reared pullets had the lowest average mortality

TABLE 9. PER CENT MORTALITY DURING LAYING PERIOD<sup>1</sup>

SERIES	RANGE REARED			CONFINED
	FULL FEED	WHOLE GRAIN	LIMITED FEED	FULL FEED
7	14.47	16.04		19.07
8	33.48	31.67		26.02
9	13.82	16.84		27.22
Average	20.59	21.51		24.11
10	11.44	18.90	12.50	
11	14.54	26.22	20.93	
12	16.92	18.50	20.42	
Average	14.30	21.20	17.95	
6-year Average	17.45	21.36		

<sup>1</sup>Average of two replicate lots.

in five of the six years, the differences are relatively small for mortality figures and probably should be interpreted as indicating that none of the feeding practices studied had any definite effect on mortality.

## General Summary

The results obtained in the experiments reported herein or elsewhere appear to justify the following conclusions concerning the feeding of heavy breed pullets during the growing period:

1. A quantitative restriction of feed during the growing period may result in retarded sexual maturity, lower feed cost, higher labor cost, and larger eggs. The most effective levels of quantitative restriction appears to be a reduction of between 20 and 50 per cent of the amount of feed consumed by full-fed pullets.

2. Qualitative restriction of feed obtained by the use of whole grains and a calcium supplement as the only feed for growing pullets on a grass or clover range produces essentially the same effects as quantitative restriction.

3. The use of a restricted feeding method of growing replacement pullets may be advisable when it is important to obtain the maximum number of large eggs.

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